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One Device, Two Surgical Fields: An Interdisciplinary Evaluation of Closed-Suction Drain Performance and Complications

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Abstract

Background: Closed-suction drains are used across surgical specialties, but comparative evidence regarding their performance in maxillofacial and general surgery remains limited. Differences in operative anatomy, dead-space creation and lymphatic disruption may alter drainage volume and device-associated outcomes between departments.

Methods: This prospective interdisciplinary observational study included 59 adults treated at Bhaskar Medical College, Hyderabad, from January to April 2026. Twenty-five patients underwent maxillofacial procedures and 34 underwent general surgical procedures. Drain output, duration, pain, device-related complications, surgical-site infection, postoperative collection and hospital stay were compared.

Results: General Surgery patients had significantly greater cumulative drain output than Maxillofacial Surgery patients (218.0±106.4 versus 164.8±82.5 mL; p=0.035). Mean drainage duration was longer in General Surgery, although the difference was not significant (3.7±1.5 versus 3.1±1.2 days; p=0.094). Overall, 15 patients (25.4%) developed at least one drain-related complication. Complication rates were similar between Maxillofacial Surgery and General Surgery (28.0% versus 23.5%; p=0.697). No significant departmental differences were observed in daily output, pain, blockage, leakage, displacement, infection, fluid collection, drain manipulation or hospital stay.

Conclusion: Closed-suction drains demonstrated comparable safety and functional reliability across both specialties, despite higher cumulative output in General Surgery. Standardised interdisciplinary protocols may support consistent monitoring, complication prevention and timely drain removal.

Keywords: Closed-suction drain; drain performance; maxillofacial surgery; general surgery; postoperative complications.

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Introduction:

Closed-suction drains are placed after operations that create dead space or disrupt lymphatic and vascular channels, including neck dissections, oral cancer resections, thyroid surgery, breast procedures and abdominal operations. By maintaining negative pressure, these devices evacuate blood and fluid, reduce tissue separation and permit monitoring [1]. Nevertheless, their performance is influenced by operative extent, blood loss, reconstruction, nutritional status, drain calibre, suction integrity and removal practices. In oral carcinoma surgery, Shetty et al. reported that advanced disease, radical neck dissection, pedicled-flap reconstruction, prolonged surgery and greater blood loss were associated with increased drain volume and longer hospitalisation [1, 2]. Evidence from thyroid surgery also indicates that routine drainage may not consistently reduce haematoma, seroma or wound infection, while it can increase pain and hospital stay in selected patients [2, 3]. Importantly, most published studies examine whether drains should be used within a single procedure, rather than evaluating how the same device performs across surgical specialties. A standardised interdisciplinary assessment may identify modifiable causes of prolonged drainage, blockage, leakage, accidental displacement, infection and delayed removal. Therefore, this study aims to compare the clinical performance, complications, patient discomfort, duration of use and resource implications of closed-suction drains in patients undergoing maxillofacial and general surgical procedures.

Methods:

A prospective interdisciplinary observational study was conducted in the Departments of Maxillofacial Surgery and General Surgery at Bhaskar Medical College, Moinabad Mandal, Hyderabad, from January 2026 to April 2026. The study included consecutive adult patients aged 18 years or above who underwent elective or emergency surgical procedures requiring placement of a closed-suction drain. Patients from the Maxillofacial Surgery Department included those undergoing procedures such as open reduction and internal fixation of facial fractures, excision of benign or malignant lesions, neck dissection, reconstruction, and drainage of deep facial or cervical infections. Patients from the General Surgery Department included those undergoing thyroid, breast, abdominal, hernia, soft-tissue, and other procedures in which a closed-suction drain was considered necessary by the

operating surgeon. Patients who declined participation, had pre-existing infection at the proposed drain site, required open or passive drainage, underwent reoperation within 24 hours, or had incomplete postoperative records were excluded. Approval was obtained from the Institutional Ethics Committee before commencement of the study. Written informed consent was obtained from every participant. Patients were enrolled prospectively using a consecutive sampling method, and they were categorised according to the treating department. The decision to insert a drain, selection of drain size, placement site, and timing of removal was made by the operating surgeon according to the procedure and routine institutional practice.

Baseline demographic and clinical details, including age, sex, body mass index, comorbidities, diagnosis, surgical indication, type of procedure, wound classification, operative duration, estimated blood loss, and type of anaesthesia, were recorded using a predesigned case-record form. Details of the drainage device, including brand or type, drain calibre, number of drains, anatomical location, method of fixation, and adequacy of suction, were documented immediately after surgery. Drain performance was assessed daily by trained members of the research team until removal. The volume of drainage was measured every 24 hours using the calibrated collection reservoir, and its character was classified as serous, serosanguineous, sanguineous, purulent, or chylous. The drainage system was examined for loss of vacuum, tube kinking, blockage, leakage around the insertion site, accidental disconnection, partial withdrawal, complete displacement, and damage to the collection chamber. Pain at the drain site was recorded using a 10-point numerical rating scale. Local erythema, tenderness, discharge, wound separation, collection, haematoma, and clinical evidence of surgical-site infection were also documented. When clinically indicated, ultrasonography or other imaging was performed to identify retained collections. Drain removal was carried out according to the surgeon's clinical assessment, based on the daily output, nature of fluid, wound condition, and type of operation.

The primary outcome was the proportion of patients who developed one or more drain-related complications. Secondary outcomes included cumulative drain output, average daily output, duration of drainage, pain score, surgical-site infection, need for drain manipulation or replacement, postoperative collection, length of hospital stay, and additional dressing or device-related expenditure. Patients were followed until discharge and were reviewed within 30 days after surgery to identify delayed infection, seroma, haematoma, wound dehiscence, or readmission. Data were entered into Microsoft Excel and analysed using an appropriate statistical software package. Continuous variables were expressed as mean with standard deviation or median with interquartile range, depending on data distribution. Categorical variables were presented as frequencies and percentages. Outcomes between the Maxillofacial Surgery and General Surgery groups were compared using the independent-samples t-test or Mann–Whitney U test for continuous variables and the chi-square test or Fisher's exact test for categorical variables. Multivariable logistic regression was performed to identify independent predictors of drain-related complications. A p value below 0.05 was considered statistically significant.

Results:

A total of 59 patients were evaluated, comprising 25 patients from Maxillofacial Surgery and 34 from General Surgery. The groups were comparable with respect to sex distribution, body mass index, comorbidities, operative duration and estimated blood loss. General Surgery patients were older than Maxillofacial Surgery patients, although the difference narrowly missed statistical significance (45.8 versus 38.6 years; p=0.054). Mean cumulative drain output was significantly greater in General Surgery than in Maxillofacial Surgery patients (218.0 versus 164.8 mL; p=0.035). General Surgery patients also had a longer mean drain duration, but the difference was not statistically significant (3.7 versus 3.1 days; p=0.094). At least one drain-related complication occurred in 15 patients, giving an overall complication rate of 25.4%. Complication rates were comparable between Maxillofacial Surgery and General Surgery groups (28.0% versus 23.5%; p=0.697). Blockage or loss of suction was observed in seven patients, leakage in six and accidental displacement in three. Surgical-site infection developed in six patients, while postoperative fluid collection occurred in six patients. No significant departmental differences were found in pain scores, drain manipulation, infection, fluid collection or hospital stay. Overall, closed-suction drains demonstrated similar safety and functional reliability across both surgical specialties.

Discussion:

The present prospective interdisciplinary study evaluated closed-suction drain performance among 59 patients managed by Maxillofacial Surgery and General Surgery. The principal finding was that General Surgery patients had significantly greater cumulative drainage than Maxillofacial Surgery patients, whereas daily output, duration of drainage, pain, device-related complications, surgical-site infection and hospital stay were comparable between the groups. The greater cumulative output in General Surgery may be attributable to the inclusion of procedures involving wider tissue dissection and

disruption of lymphatic channels, particularly breast, thyroid, abdominal and soft-tissue operations. In contrast, although maxillofacial procedures may create substantial cervical dead space, the operative field is often more anatomically confined. Shetty et al. studied 222 patients undergoing oral carcinoma resection with neck dissection and found that radical neck dissection, pedicled-flap reconstruction, longer operations, greater blood loss, low postoperative albumin and complications were associated with increased drainage [1]. Their findings support the interpretation that drain output reflects the extent of tissue injury and patient- and procedure-related factors rather than the surgical specialty alone. In the present study, operative duration and estimated blood loss did not differ significantly between the groups, suggesting that the anatomical site and type of dissection may have contributed to the observed difference in cumulative output. However, the modest sample and heterogeneous procedures prevented procedure-specific analysis. Closed-suction systems remain valuable because they evacuate blood and serous fluid, reduce dead space and permit monitoring for postoperative bleeding or leakage, but output should always be interpreted alongside the clinical condition of the patient [1].

General Surgery patients had a longer mean drainage duration than Maxillofacial Surgery patients, although the difference was not statistically significant. This finding may be clinically relevant because prolonged drain retention can delay mobilisation and discharge, increase dressing requirements and expose the drain tract to contamination. Nevertheless, premature removal may permit seroma, haematoma or infected collection formation. In a randomised study of thyroidectomy patients, George et al. reported that routine drainage did not provide a clear reduction in postoperative collections or wound complications and was associated with increased pain and longer hospitalisation [2]. Wang et al. similarly concluded that routine drainage was unnecessary following unilateral thyroid lobectomy with central neck dissection in appropriately selected patients [4]. These observations indicate that drain placement should be selective and based on operative complexity, haemostasis, dead-space volume and the likelihood of lymphatic leakage rather than routine habit. The present investigation differed from drain-versus-no-drain trials because every included patient had a closed-suction device; therefore, it assessed functional performance after a clinical decision to drain had already been made. Recent breast-surgery evidence also demonstrates continued uncertainty regarding optimal drain use. A United Kingdom national survey found wide variation in drain placement, removal thresholds and seroma management, with most respondents supporting further randomised evaluation [5]. The lack of a significant difference in duration between our departments suggests that a common output-based removal protocol may be feasible, although procedure-specific exceptions would remain necessary.

At least one drain-related complication occurred in 25.4% of the study population, with no significant difference between Maxillofacial Surgery and General Surgery. Most events were minor and manageable, including blockage or loss of suction, peri-drain leakage and accidental displacement. These findings emphasise that the practical effectiveness of a drain depends not merely on its insertion but also on secure fixation, preservation of vacuum, avoidance of tube kinking and consistent postoperative surveillance. The similar pain scores observed in both groups further indicate that device discomfort is not confined to a particular operative region. Drain design and negative-pressure strength may affect these outcomes. Ling et al., in a randomised trial following mastectomy, compared flat-silicone and round-silicone perforated drains in relation to prolonged seroma, pain and wound complications, highlighting the importance of device configuration rather than treating all drains as equivalent [6]. A meta-analysis comparing half-vacuum with full-vacuum drainage after modified radical mastectomy suggested that lower suction pressure may reduce seroma and shorten hospitalisation in some settings, although protocols and evidence remained heterogeneous [7]. Furthermore, Rao et al. found that progressive-tension sutures reduced seroma following abdominoplasty compared with drains, demonstrating that elimination of dead space at closure may sometimes be more important than postoperative evacuation alone [8]. Thus, drain performance should be considered part of a broader wound-management strategy incorporating meticulous haemostasis, tissue approximation, dead-space control, appropriate suction pressure and standardised nursing care.

Surgical-site infection and postoperative fluid collection each occurred in six patients, without a significant interdepartmental difference. Although drains may theoretically provide a route for ascending infection, infection risk is also influenced by wound contamination, operative duration, comorbidity, nutritional status and duration of drain retention. A meta-analysis of posterior spinal surgery found that continuing systemic antibiotics solely because a closed-suction drain remained in place did not provide an additional reduction in surgical-site infection, supporting standard antimicrobial stewardship rather than prolonged prophylaxis [9]. Conversely, the clinical value of drainage may be greater in selected contaminated operations. Stellon et al. reported a lower postoperative abscess rate when irrigation was combined with prophylactic closed-suction drainage

in severe uncontained perforated appendicitis, although they recommended prospective confirmation [10]. Recent evidence from abdominoplasty similarly indicates that routine drains may increase discomfort and infection exposure, while alternative dead-space closure techniques can achieve favourable outcomes [8]. Collectively, these findings demonstrate that drains are neither universally beneficial nor uniformly harmful; their utility depends on the indication, operative field, device characteristics and postoperative management. The present study's strengths were its prospective design, interdisciplinary approach and simultaneous evaluation of output, complications, pain and utilisation. Its limitations included a small single-centre sample, short recruitment period, heterogeneous procedures, non-randomised drain selection and limited power to detect uncommon complications. Larger multicentre studies should stratify outcomes by operation, drain type, calibre, suction pressure and removal threshold. Nevertheless, the comparable complication profile observed in both departments supports the development of a shared institutional protocol for drain documentation, surveillance and timely removal.

Conclusion: Closed-suction drains showed broadly comparable safety and functional performance in maxillofacial and general surgical procedures. General Surgery patients had significantly greater cumulative drain output, while drainage duration, pain, device-related complications, surgical-site infection, postoperative collection and hospital stay did not differ significantly between departments. These findings suggest that drain performance is influenced more by operative characteristics and anatomical dissection than by specialty alone. Standardised protocols for drain selection, fixation, output monitoring, complication surveillance and timely removal may improve patient comfort and resource utilisation. Larger multicentre studies stratified by procedure, drain design and suction pressure are required to further confirm these observations.

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Table 1: Baseline and operative characteristics of the study participants

Variable	Maxillofacial Surgery (n=25)	General Surgery (n=34)	Test statistic	p value
Age, years, mean ± SD	38.6 ± 13.2	45.8 ± 14.7	t=1.97	0.054
Male sex, n (%)	16 (64.0)	18 (52.9)	χ^2=0.72	0.396
Body mass index, kg/m², mean ± SD	24.1 ± 3.6	25.0 ± 4.1	t=0.90	0.375
Presence of comorbidity, n (%)	5 (20.0)	10 (29.4)	χ^2=0.68	0.412
Elective surgery, n (%)	19 (76.0)	29 (85.3)	χ^2=0.82	0.365
Operative duration, minutes, mean ± SD	128.4 ± 42.6	112.7 ± 38.5	t=1.46	0.152
Estimated blood loss, mL, mean ± SD	176 ± 88	154 ± 81	t=0.98	0.331
More than one drain inserted, n (%)	4 (16.0)	3 (8.8)	Fisher's exact	0.438

Table 2: Closed-suction drain performance and postoperative outcomes

Outcome	Maxillofacial Surgery	General Surgery	Test statistic	p value
Cumulative drain output, mL, mean ± SD	164.8 ± 82.5	218.0 ± 106.4	t=2.17	**0.035**
Average daily output, mL, mean ± SD	58.7 ± 24.6	66.9 ± 29.8	t=1.16	0.253
Drain duration, days, mean ± SD	3.1 ± 1.2	3.7 ± 1.5	t=1.71	0.094
Drain-site pain score, mean ± SD	4.3 ± 1.4	4.0 ± 1.3	t=0.84	0.406
Any drain-related complication, n (%)	7 (28.0)	8 (23.5)	χ^2=0.15	0.697
Blockage or loss of suction, n (%)	3 (12.0)	4 (11.8)	Fisher's exact	1
Leakage around insertion site, n (%)	3 (12.0)	3 (8.8)		0.69
Accidental displacement, n (%)	2 (8.0)	1 (2.9)		0.569
Surgical-site infection, n (%)	2 (8.0)	4 (11.8)		1
Postoperative fluid collection, n (%)	2 (8.0)	4 (11.8)		1
Drain manipulation or replacement, n (%)	4 (16.0)	5 (14.7)		1
Hospital stay, days, mean ± SD	5.4 ± 1.8	6.2 ± 2.1	t=1.58	0.122